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**APPLICATION NUMBER:** ***60/749,364***
**FILING DATE:** ***December 09, 2005***

**THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS** ***US60/749,364***

**By Authority of the**
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M. K. Carter

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30847 U.S. PTO

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# PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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**TITLE OF THE INVENTION (280 characters max)**

COMBINED CONTACT FEED FOR INTERNAL ANTENNA

*Direct all correspondence to:* **CORRESPONDENCE ADDRESS**

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**ENCLOSED APPLICATION PARTS** *(check all that apply)*

[X] Specification — *Number of Pages (Incl. Drawings)* 5
[ ] CD(s), Number
[ ] Drawing(s) — *Number of sheets*
[ ] Other (specify)
[ ] Application Data Sheet. See 37 CFR 1.76

**METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)**

[X] Applicant claims small entity status. See 37 CFR 1.27.
[X] A check or money order is enclosed to cover the filing fees
[X] The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 01-0035
[ ] Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): $100

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.
[x] No.
[ ] Yes, the name of the U.S. Government agency and the Government contract number are: ______

*Respectfully submitted,*

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Date December 9, 2005
REGISTRATION NO. (if appropriate) 24,156
Docket Number: 207,372

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## Additional Page

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| Docket Number | 207,372 | Type a plus sign (+) inside this box → | + |
|---|---|---|---|

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## DISCLOSURE ANSWERS

A. **Title/Subject Matter of the Invention:** COMBINED CONTACT FEED INTERNAL ANTENNA

**Persons Who Contributed to or Worked on the Invention:** Charlie (Eun-gyu) Bae, Haim Yona and Snir Azulay, GTT team – please see e-mail from 1 December.

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B. **Purpose of the invention:** To create a small, high efficiency, cost effective internal antenna with broadband coverage. The antenna would perform well in single as well as multi-band implementations.

C. **A summary of invention: How does the present invention solve the problem; what are the differences between this solution and the prior solutions; and what are the advantages provided by the invention:**

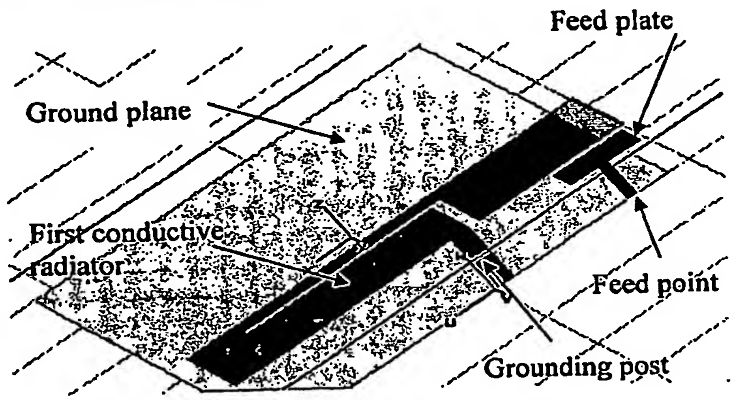
Multi-band Inverted F Antennas (IFA, PIFA etc) designs tend to be physically large and lack sufficient bandwidth, especially in the low bands. Folded Monopole Antennas (FMA) have high efficiency even in small multi-band designs, but also lack sufficient bandwidth. Dielectrically excited antennas solve the size and bandwidth issues, but at a significant cost due to expensive dielectric components.

U.S. Patent 5,434,579 (Kagoshima et al) describes a non-contact feeding structure for a PIFA, using a dielectric substrate between the ground plane and capacitive feeding plate. The size of the capacitive plate is used for impedance matching.

In the invention described here, we use a variation of the capacitive feeding structure to create a broadband antenna that does not necessarily include a ground plane beneath the radiating element. Further, improved specific band response can be obtained by using radiating slots in the conductive element. Further development includes both direct contact and capacitive feeding structure in parallel.

This inventions' capacitive feeding structure does NOT require a dielectric substrate between it and the ground-plane. We call it a Simple Capacitive Feed (SCF)

## *D.* Description of the invention




The antenna consists of a first conductive radiating element generally located above a conductive ground plane, but not necessarily fully overlapping with the ground plane. A grounding post connecting the first conductive radiating element to the ground plane.

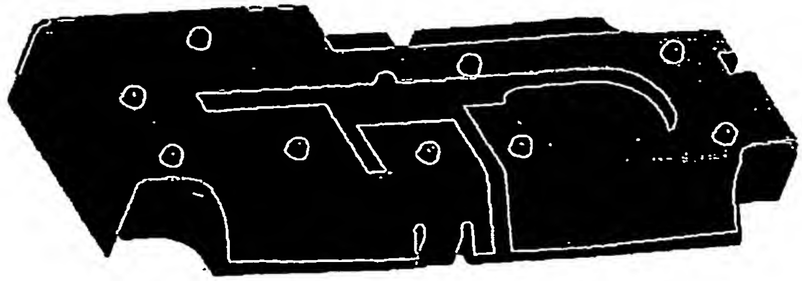
A feed plate element placed between the first conductive radiating element and ground plane connected directly to the feed point of the device for the purpose of capacitive feeding of the first conductive radiating element. There is no need for a dielectric substrate between the feed plate element and the ground plane or the first conductive radiating element, though one can be used to reduce the physical size. The size of the feed plate element and its distance to the first conductive radiating element can be changed to give correct impedance matching. Choice of material in between the feed plate element and the first conductive radiating element also affect the capacitive feeding structure created.

Implementation of first conductive radiating element may or may not utilize radiating and tuning slots.

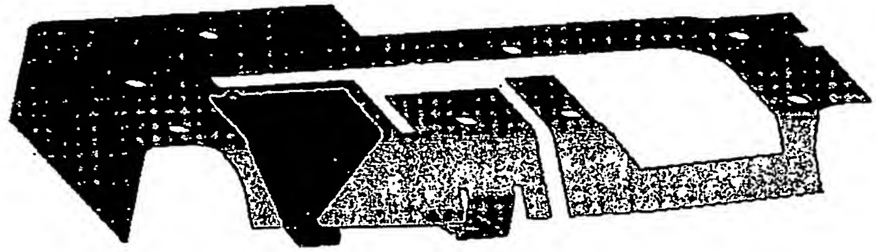
First possible implementation is a "loop" antenna where the SCF capacitive feed is on one end of the first conductive radiating element, the ground post is on the far end of the first conductive radiating element, with the loop bending parallel to itself creating a slot that also radiate at specific bands. The ground plane may or may not be fully parallel to and beneath the first conductive radiating element. The first conductive radiating element may or may not include tuning flaps

Second possible implementation utilizes a more traditional Planar structure where the SCF capacitive feed and the grounding post are located near each other. The implementation may or may not include radiating and tuning slots or tuning flaps, and may or may not have a ground plane fully beneath the first conductive element.

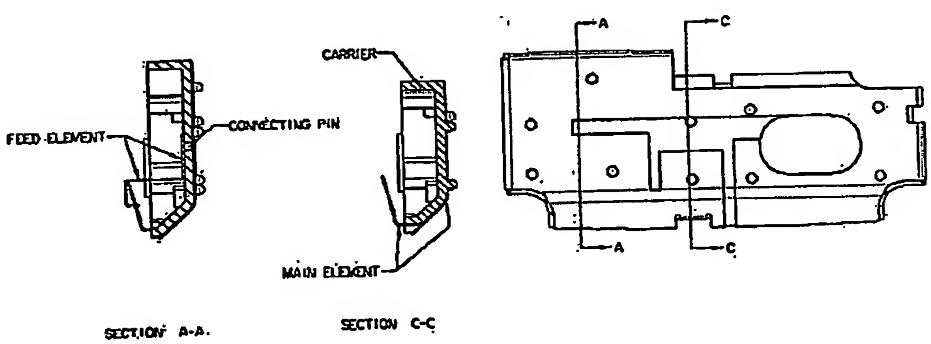
Another embodiment of the invention



Pic. 1 - Top view of antenna with combined direct and capacitive feed



Pic. 2 - The main element (radiator), feed element and direct contact of antenna of above picture shown – main element drown transparent in order to show the other piece parts, carrier is not shown




Pic 3 - Assembly drawing of the antenna with combined direct and capacitive feed

In all of the above embodiments a ceramic dielectric puck can be incorporated

As well as a combined capacitive with inductive feed can be included

E. **Differences Between Invention and Other Systems or Methods:**

In the invention described here, we use a variation of the capacitive feeding structure to create a broadband antenna that does not necessarily include a ground plane beneath the radiating element. Further, improved specific band response can be obtained by using radiating slots in the conductive element.

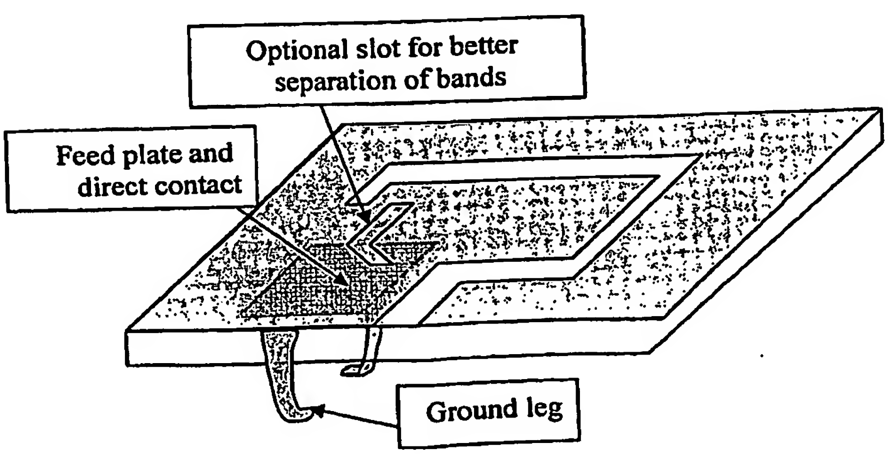
This inventions' capacitive feeding structure does NOT require a dielectric substrate between it and the ground-plane. We call it a Simple Capacitive Feed (SCF).

One embodiment of the invention, in contrast to the standard PIFA and/or prior art antennas, feeds the antenna at the point of high impedance. The benefit of this construction is that the bandwidth of the antenna is significantly increased and the overall size of the antenna is smaller.

The following are notes for antenna with combined direct and capacitive feed:

One of the key parameters in successful 'non-contact feed internal antenna' designs is the (level of) coupling between the feed plate and main antenna element. Different frequencies result different coupling requirements. In standard PIFA design relatively high inductance of thin and long direct contact is a limiting factor of bandwidth especially in higher bands. In lower bands a direct contact can be a good solution, for similar performance the size of feed plate is getting very large in design of capacitive feed antenna. In capacitive feed the inductive reactance is anyhow reduced by wider feed (contact) and by serial capacitance involved in design. Adding a very short direct contact –(to be in parallel with capacitor) allows keep the feed plate in small size.
Results show this combination can improve the performance in lower bands neither without degradation in higher bands nor without penalty of higher cost of large feed plate.

In another application of this invention the capacitive feed results in increased bandwidth in lower bands due to the reduced inductive reactance, which works very well for matching purposes in combination with a shunt inductor. In the same application the higher frequencies do benefit from the direct contact for increased matching bandwidth. However both need to be connected to the same ground contact (gamma match), which can be achieved with the specific layout. Optional the combined feed mechanism may or may not be enhanced by adding a slot for separation of low and high bands.



F. **Prior Art:**

US 5434579: Inverted F antenna with non-contact feeding
US 5764190: Capacitively loaded PIFA
US 6680705: Capacitive feed integrated multi band antenna